# Ion release and Biocompatibility of Ti-6Al-4V Alloys for Dental application

Jung-In Kang[a*], Mee-Kyoung Son[a], Han-Cheol Choe[b]
[a*]Department of Dental Prosthodontics, School of Dentistry, Chosun University, Gwangju, Korea
[b] Department of Dental Materials, Research Center of Nano-Interface Activation for Biomaterials, School of Dentistry, Chosun University, Gwangju, Korea
([*]Corresponding author E-mail: hcchoe@chosun.ac.kr)

**Abstract:** In order to investigate ion release and biocompatibility of Ti-6Al-4V dental alloy by electrochemical corrosion test and MTT assay, commercial Ti-6Al-4V alloy rod (99.99% Ti, USA, Co) were used in the study. The microstructure of the alloys was examined by optical microscopy (OM), Field emission scanning electron microscopy (FE-SEM), energy dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), MTT assay, and corrosion test. From the polarization curves, very low current densities were obtained for Ti–6Al–4V alloys, indicating a formation of stable passive layer.

## 1. Introduction

Titanium and titanium alloys continue to be the best choice as orthopedic and dental implant materials due to their excellent biocompatibility and mechanical properties.
Among the different titanium alloys ($\alpha$, $\alpha+\beta$, $\beta$), the $\alpha+\beta$ type Ti-6Al-4V alloy is the most employed biomaterial with proven clinical success. Usually $\alpha+\beta$ microstructure of the alloy is particularly important when a greater modulus of elasticity is in need, such as bone plates.

## 2. Experimental

Commercial Ti-6Al-4V alloy rod(99.99% Ti, USA, Co) were used in the study. Samples were divided into 2 group, one group sample was raw rod type wire (10mm diameter and 4 mm thickness), and the other group was machined implant supplied by KJ Meditech, Co. Each sample was cut and prepared using a high-speed diamond cutting machine with 2000 rpm speed, followed by polishing with 3 $\mu$m $Al_2O_3$paste. The electrochemical potentiodynamic polarization studies for corrosion behaviors were carried out in 0.9% NaCl solution at 36.5 ± 1° C using a potentiostat. A conventional three-electrode system with high-density graphite as counter electrode and saturated calomel electrode (SCE) as reference was used. The electrolyte was deaerated using high-purity Ar gas for 30 min before starting the experiment. Deaeration was continued at a uniform rate during the experiment. The potentiodynamic polarization test with a scan rate of 1.67 mV s−1 was carried out from −1500 mV to 2000 mV. The crystallinity and morphology of surface were examined by OM, FE-SEM, EDS, and XRD. Briefly, cells (1 x $10^5$ per well) were seeded into 24-well plates. After drug treatment, 3-(4,5-dimethylthiazol-2-yl)-2, 5-diphenyl-tetrazolium bromide (MTT) solution (5 mg/mL in PBS) was added, and cells were incubated at 370° C for 3h. The culture medium was then aspirated, and acid isopropanol (0.04 mol/L hydrogen chloride (HCl) in isopropanol) was added to dissolve the dark blue crystals. The optical density value of the dissolved solute was then measured using a Microplate Autoreader (Bio-Tek Instruments Inc., Winooski, VT) at a wavelength of 540 nm.

## 3. Conclusion

The microstructure of Ti-6Al-4V alloys showed $\alpha+\beta$ phase structure. Ti-6Al-4V alloys were improved in the case of machined surface.
From the polarization curves, very low current densities were obtained for Ti–6Al–4V alloys, indicating a formation of stable passive layer.
(This research was supported by Innovation and Creativity through the Ministry of Education and National Research Foundation of Korea 2015H1C1A1035241:hcchoe@chosun.ac.kr).

## References

1. V.S. Saji, Y.H. Jeong, H.C. Choe, Corrosion behavior of Ti-13Nb-13Zr and Ti-6Al-4V alloys for biomaterial application. CORROSION SCIENCE AND TECHNOLOGY, 9 (2010), 12.
2. C.G. Nava-Dino, C. López-Meléndez, R. G. Bautista-Margulis, M. A. Neri-Flores, J.G. Chacón-Nava, S.D de la Torre, J.G. Gonzalez-Rodriguez, A. Martínez-Villafañe. Corrosion behavior of Ti-6Al-4V alloys. Int. J. Electrochem. Sci, 7 (2012), 2389.